



RISK MANAGEMENT OF RICE SUPPLY CHAIN BASED ON RISK CORRELATION (Case Study: Penajam Paser Utara)

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ABSTRACT

Rice is the staple food with a continuous increase of it's demand. Therefore, it's availability should be well-maintained. Rice farmers and millers don't yet have an advantageous position. Other risks also has the potential to disrupt the rice production process. This study aims to analyze and create priority risk mitigation in the rice supply chain of PPU. The methods used in this research were ISM to create a risk structure, FMECA to assess risk, and AHP to mitigate priority risk. There were 41 risks, consist of 26 risks for farmers and 15 risks for millers. Based on FMECA result, the priority risk from farmers is poor quality rice seeds (RPN of 112 and a medium criticality level). The priority risk from millers is damage to the rice grinder machine (RPN of 490 and a very high criticality level). The mitigation strategies were prepared by considering the interrelationships between risks in the ISM. If totaled based on the results, there were 11 risks for farmers that could be overcome by the 6 alternative mitigation strategies that exist. As for the rice mill, there were 6 risks that could be overcome by the 4 alternative mitigation strategies that exist. All of these alternatives were calculated using the AHP method. The priority mitigation for the farmer's were routine monitoring and maintaining the moisture content of the seeds, while the priority mitigation for the millers were periodic maintenance scheduling and the provision of spare engine components.

Keywords: Risk, Supply Chain, ISM, FMECA, AHP

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1. INTRODUCTION

The agricultural sector is still the main pillar of the Indonesian economy. The contribution of the agricultural sector to the Indonesian economy can be seen from the GDP contribution of 14.27% in the second quarter of 2021 (BPS, 2021). The agricultural sector not only supplies national food but is also the main source of livelihood for most of Indonesia's population (Todaro, 2000 in Baihaqi et al. 2019).

According to Isaac et al. (2013) in Profita and Rahayu (2018), East Kalimantan introduces the vision of "Kaltim Maju 2030" to achieve fair and sustainable green economic growth by utilizing the agricultural sector to encourage economic growth in East Kalimantan. To make this happen, the provincial government of East Kalimantan has designated Penajam Paser Utara (PPU) as a food crop industrial area. With a planting area of 15,306 ha, it is hoped that this regency will be able to become a center for food product production in East Kalimantan in 2030 (BPS Kabupaten PPU, 2020).

The agricultural sector has the second largest GRDP contribution in PPU after the mining sector, which is 20.75% (RPJMD PPU, 2019). One of the most widely produced agricultural commodities in PPU in 2019 was rice, with a production output of 41,622.32 tons of GKG, or the equivalent of 24,085.68 tons of rice (BPS Regency PPU, 2020). Rice is considered the main source of carbohydrates, which is the staple food for the majority of Indonesians. From the latest data, it is known that the national rice consumption was 29.13 million tons, or 111.58 kg per capita per year in 2017. The average growth rate of the Indonesian people from the 2010-2020 period was relatively high at 1.25%, so that the demand for the public's interest in rice also continues to increase (BPS, 2019; BPS, 2020). In fact, according to BPS 2020 data, it is estimated that rice consumption could reach 31.7 million tons in 2045. For this reason, the availability of rice as a staple food should be maintained.

Rice farmers and millers are the main players in the rice supply chain. Farmers are producers of rice commodities in the form of GKP and GKG in the rice supply chain. However, this does not guarantee them the greatest profits. This is because prices are determined by the market, while operating costs

continue to swell. Farmers are classified as a low-income sector in Indonesia. According to BPS data in 2020-2021, households with poor status in Indonesia are dominated by people who work in the agricultural sector, which ranges from 45-51%. In addition, rice millers are major players that contribute greatly to increasing the value of the rice supply chain. However, rice millers actually make little profit from rice production due to high production costs. So that additional profit is obtained from the sale of other rice derivative products (Swastika & Sumaryanto, 2012 in Octania 2021). There are other risks, such as a decrease in the quality of the harvest and damage to the equipment, which also interferes with the rice production process.

Previous research conducted by Profita and Rahayu (2018) had carried out a preliminary for the management of agricultural supply chains in PPU, but only reached the stage of risk identification. Further research is needed in order to get a more complete picture of the development of rice supply chain management at PPU. For this reason, this study was conducted to analyze the major risks of the rice supply chain in the upstream sector (which includes farmers to rice millers) in PPU, in order to optimize agricultural potential and profits. In this study, risk correlation was achieved through the use of Interpretive Structural Modeling, which was then used to develop mitigation strategies. For risk assessment, it is calculated using Failure Mode Effect Critical Analysis to determine priority risks that need to be mitigated. As well as using the Analytical Hierarchy Process in determining priority of mitigation in order to reduce the frequency and impact of risks.

2. METHODOLOGY

2.1. Risk Management

According to Fathoni (2020), risk management is a process that includes identification, assessment, evaluation, and strategy development to manage risk. Risk management aims to reduce the adverse effects caused by risks by preparing a treatment plan to deal with these risks. There are at least 4 types of individual and group reactions when handling risk, namely avoiding risk, reducing risk, facing risk, and sharing risk. Meanwhile, in making

decisions related to risk, it is classified into 3 categories, namely in certain conditions, under risk conditions, and in uncertain conditions.

2.2. Interpretive Structural Modeling

Interpretive Structural Modeling (ISM) analyzes elements and describes the relationships between elements in a graph. These elements can be used for policies, evaluation factors, and others. The first step in an ISM analysis is to identify the elements that are relevant to the problem at hand. Then set the sub-elements in each selected element. Then the results are arranged in a Structural Self Interaction Matrix (SSIM), which is implemented into the Reachability Matrix (RM) table by changing V, A, X, and O into numbers 1 and 0. The classification of elements is as follows:

Rating V, if e_{ij} (row) = 1, then e_{ji} (column) = 0,
 Rating A, if e_{ij} (row) = 0, then e_{ji} (column) = 1,
 Rating X, if e_{ij} (row) = 1, then e_{ji} (column) = 1, and

Rating O, if e_{ij} (row) = 0, then e_{ji} (column) = 0. (Marimin, 2008; Saxena, 1994 in Rimantho & Rosdiana, 2017).

A value of 1 indicates that there is a relationship between i element and j element, while $e_{ij} = 0$ means that there is no contextual relationship between i element and j element. Then by changing VAXO to 1 and 0 in the reachability matrix, testing is carried out to improve the consistency of the matrix using the transitivity rule (if A affects B and B affects C, then A will also affect C), so that it becomes a closed matrix. This matrix is further processed to obtain Driver Power (DP) and Dependence (D). The last stage is the grouping of sub elements into 4 sectors, namely:

1. A small number of DP and D variables (Autonomous),
2. A small number of DP variables and a large number of D variables (Dependant),
3. A large number of DP and D variables (Linkage), and
4. A large number of DP variables and a small number of D variables (Independent). (Saxena, 1994 in Rimantho & Rosdiana, 2017).

2.3. Failure Mode and Effect Critically Analysis (FMECA)

According to Jaya et al. (2019), FMECA consists of 2 stages: Failure Mode and Effect Analysis (FMEA) and Criticality Analysis (CA). FMEA serves to determine the cause of failure that causes loss of efficiency and effectiveness of the supply chain system. While CA serves to assess the critical point of risk and identify the complexity of each failure. Evaluation of the point of failure can be done using the Critical Number (CN) or Risk Priority Number (RPN) approach.

Priority risk is determined based on the highest RPN result, but the FMEA method only consists of simple calculations that will allow several risks to have the same RPN result. This is what is refined in the FMECA method, in which there is a criticality determination process. If there is a condition where several risks have the same RPN value, it is necessary to review the Criticality Matrix (CM) further. A Criticality matrix is a means to facilitate the identification and comparison of each risk in a system, especially related to the level of impact caused by each risk. Although there are several risks with the same RPN results, those with a higher severity value will be prioritized to be handled (Department of the Army, 2006). The Chartered Quality Institute in Maghfiroh and Wibowo (2019) categorizes the criticality of using RPN into several classes, as shown in Table 1 below.

Table 1. FMECA Criticality Assessment

Kekritisian		Result
Criticality level	RPN	
Very low	1-50	Acceptable
Low	51-100	
Medium	101-150	Avoidable
High	151-200	Mitigatable
Very high	201-250 (>250)	Mitigatable

2.4. Analytical Hierarchy Process

Nugroho and Hartati (2012) in Umar et al. (2018) describe the Analytical Hierarchical Process (AHP) as a method for prioritizing in solving a complex problem. According to the AHP method, priorities are divided into several stages:

1. Create a hierarchy,
2. Assess the criteria and alternatives,
3. Establish a priority, and
4. Determine the value of logical consistency.

Kusrini (2007) in Sanyoto et al. (2017) stated that pairwise comparisons were used to

assess criteria and alternatives. Saaty (1988) in Sanyoto et al. (2017) revealed that the best scale for opinion assessment is a scale of 1-9. Measurement of qualitative assessment using the Saaty comparison scale is shown in Table 2 below.

Table 2. Saaty Comparison Scale

Intensity of interest	Description
1	Both elements are equally important
3	One element is a little more important
5	One element is more important than the other elements
7	One element is much more important than the other elements
9	One element is absolutely more important than the other elements
2,4,6,8	The value between two adjacent considerations
Opposite	If activity i gets 1 point compared to activity j, then j has the opposite value

2.5. Object and Research Location

This research was conducted by collecting data in Babulu District, PPU, East Kalimantan. The data sources used in this study are divided into two parts, namely primary data and secondary data. The primary data sources for this study were obtained through a questionnaire, which included the assessment of VAXO on the SSIM; data on causes, impacts, and priority risk responses; assessment of severity, occurrence, and detection; and assessment of criteria and alternatives. All of these questionnaires were filled out by the same respondent. The respondents of this study were representatives of the chairman of the Setia Abadi Farmer's Group and the owner of the UD Sido Muncul rice mill. Each respondent will be assessed according to the risks that exist in their respective scope of work.

Secondary data from this study includes data on risk identification from previous studies, articles, books, and other literature. For risk

identification, it was obtained from a study entitled "Development of a Sustainable Agri-Food Supply Chain Performance Measurement Model Based on Risk Management" by Profita and Rahayu (2018), which is a preliminary study of this study, as well as from the research of Yahman et al. (2020). After all this data is obtained, the next step is to process the data, which consists of making a risk correlation, risk assessment, and risk mitigation strategies.

3. RESULT AND ANALYSIS

3.1 Risk Correlation

According to Appendix 1, the correlations for the 26 risks of farmers are divided into 3 levels. The division of levels is based on the number of iterations of each risk. The more iterations of a risk, the higher the level occupied. A high level of risk indicates that the risk has many links with other risks. If we only look at Appendix 1, the three risks that are at level 3 (R19, R20, and R35) should be priority risks because they tend to affect the emergence of other risks. However, based on the assessment using the FMEA method, the three are not considered priority risks. R19 has an RPN of 30 and R20 has an RPN of 16, both of which are classified as a risk with very low criticality. As for R35, although it is a risk with the highest RPN of 112, there are 3 other risks with the same RPN. So it is necessary to re-compare the severity values of the four risks. Based on the comparison result, the severity value of R35 is still lower than the other 3 risks. Therefore, R35 can't be considered as the main root cause and can't be a priority risk for farmers.

Based on Appendix 2, the relationship between the 15 risks of rice millers is divided into 4 levels. If we only look at Appendix 2, the risk at level 4 is R8 (fuel that runs out during the production process). This should be a priority risk because it tends to affect the emergence of other risks. However, based on the assessment using the FMEA method, this risk doesn't include priority risk. R8 has an RPN of 42 and is only classified as a risk with very low criticality. To determine priority risk, it is seen from the highest RPN in which there are assessments of severity, occurrence, and detection. In addition, although R8 can be a trigger, R8 is not the only trigger for other risks. There are several risks at level 2, which are also the initial triggers for other risks such as R9, R10, R12, R13, and R16. Therefore, R8 can't be considered as the main

root cause and can't be a priority risk for rice millers. The interrelationships between risks (Appendix 1 and 2) will be taken into consideration for developing a mitigation strategy for the priority risk of each player.

3.2 Risk Assessment

The FMECA method was used to assess risks, with The resulting output being a priority risk for each rice supply chain player in PPU. The risk assessment is described as follows:

Table 3. Risk Assessment of Farmers

	Risk	S	O	D	RPN	Criticality
R1	Inadequate irrigation	7	2	1	14	Very low
R2	Poor quality rice seeds	8	2	7	112	Medium
R3	Rice seeds weren't always available	6	2	1	12	Very low
R4	Lack of equipment and machinery hampers the work of farmers	3	5	1	15	Very low
R5	Due to a scarcity of fertilizers, fake fertilizers circulate	5	3	3	45	Very low
R6	Limited capital	5	4	1	20	Very low
R18	The price of rice or grain is not in accordance with the standards set by the government	2	7	4	56	Low
R19	Regulations on rice planting procedures that weren't in accordance with land conditions	3	2	5	30	Very low
R20	Complicated bureaucracy	2	2	4	16	Very low
R21	Regulations that were considered unfavorable to farmers	3	2	3	18	Very low
R22	Agricultural insurance policies made by the government haven't been well socialized among farmers	3	7	5	105	Medium
R23	Expensive labor costs	2	4	3	24	Very low
R24	A decrease in agricultural land due to the opening of oil palm plantations.	4	5	3	60	Low
R25	The selling price of rice is not stable	4	6	4	96	Low
R26	Harvest time coincides with other regions so that the harvest is abundant and there is intense competition	4	7	4	112	Medium
R27	Prices and product demand were low during the harvest season	4	7	1	28	Very low
R28	Poor product quality reduces demand	6	4	2	48	Very low
R30	Decrease in price due to the poor quality of crops	5	3	2	30	Very low
R31	Prices of raw materials and agricultural equipment fluctuate	2	6	6	72	Low
R35	The weather is unstable	2	7	8	112	Medium
R36	Drought that affects land dryness	4	5	5	100	Low
R37	Flood	7	2	8	112	Medium
R38	Poor quality of agricultural land	4	3	2	24	Very low
R39	Pest and disease resistance to pesticides	4	5	5	100	Low
R40	Soil damage due to the use of pesticides	4	2	3	24	Very low
R41	Waste around agricultural land from companies and plantations	4	2	3	24	Very low

Based on Table 3, the risk from farmers has a critical level that is classified as very low to

medium. The criticality matrix of farmer's risk can be seen in Figure 1 below.

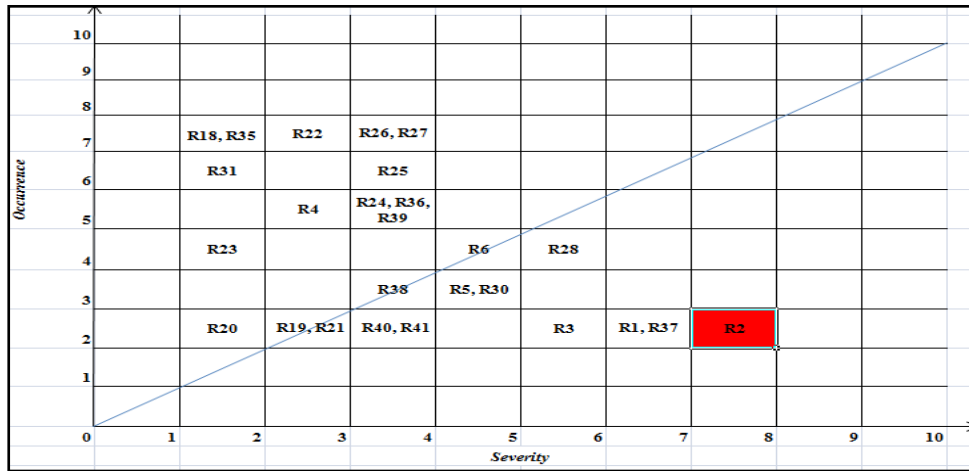


Figure 1. The Criticality Matrix of Farmer's Risk

In the FMECA method, priority risk determination can be done by looking at the risk with the highest RPN in the criticality matrix. However, if there is a risk with the same RPN, then another reference is to look at the severity value. If we only look at the results of the RPN, there were 4 farmer risks with the highest RPN of 112. The four risks include R2, R26, R35, and R37. R2 was chosen as a priority risk compared to the other three risks, because R2 has the highest severity value of 8 in the criticality matrix. From these priority risks, it is necessary to know the impact and causes in order to be able to make the right mitigation strategy. Apart from discussions with representatives of the chairman of the Setia Abadi Farmer's Group,

priority risk mitigation was also based on consideration of the interrelationships between risks using the ISM method (Appendix 1). For priority risk of farmers, R2 (poor quality rice seeds) have 7 trigger risks and 5 triggerable risks. Judging from the 7 risks that trigger R2, there were 3 risks (R38, R39, R40) which were risks related to the environment. So we need several risk mitigation strategies that can reduce the negative impact on the environment. As for the other triggers of the R2 have to do with the weather, which is difficult to control. So that the other four risks weren't considered in the preparation of mitigation strategies. Priority risk data of farmers can be seen in Table 4 below.

Table 4. Priority Risk Data of Farmers

Priority risk	Potential impact	S	Potential cause	O	Mitigation action	D	RPN
R2	<ul style="list-style-type: none"> - Reducing the quality of the rice produced - Lowering demand from customers - Lowering the selling price 	8	Unattended seed storage	2	<ul style="list-style-type: none"> - Maintain the seed's moisture content - Provide adequate ventilation - Choosing the right packaging 	7	112
			Pest and disease control was less than optimal		<ul style="list-style-type: none"> - Utilization of botanical pesticides - Fumigant spraying - Routine monitoring 		

After obtaining priority risks from farmers along with several alternatives proposed as mitigation measures, proceed with conducting a

risk assessment for rice millers, which can be described as follows:

Table 5. Risk Assessment of Rice Millers

Daftar Risiko		S	O	D	RPN	Criticality
R7	Delay in the production process	2	5	4	40	Very low
R8	Fuel runs out during the production process	7	6	1	42	Very low
R9	Power outage	2	5	10	100	Low

R10	Damage to the rice grinders machine	7	7	10	490	Very high
R11	Uneven heating of the oven	3	5	5	75	Low
R12	Damage to the oven	4	4	10	160	High
R13	Damaged packaging machines and tools	3	6	10	180	High
R14	The rice grains were crushed during milling	4	4	3	48	Very low
R15	Rice packaging runs out during the production process	2	6	2	24	Very low
R16	Damage to supporting infrastructure	3	5	10	150	Medium
R17	Delays in distributing rice to customers	3	6	5	90	Low
R29	The rice produced wasn't according to the customer's wishes	4	4	8	128	Medium
R32	Damaged to the rice and packaging during storage	3	6	4	72	Low
R33	There were competitors who bought rice or unhusked rice	5	8	10	400	Very high
R34	Late payments by customers	5	7	10	350	Very high

Based on the results in Table 5, the risk of rice millers has a criticality level that is classified

as very low to very high. The criticality matrix of rice miller's risk can be seen in Figure 2 below.

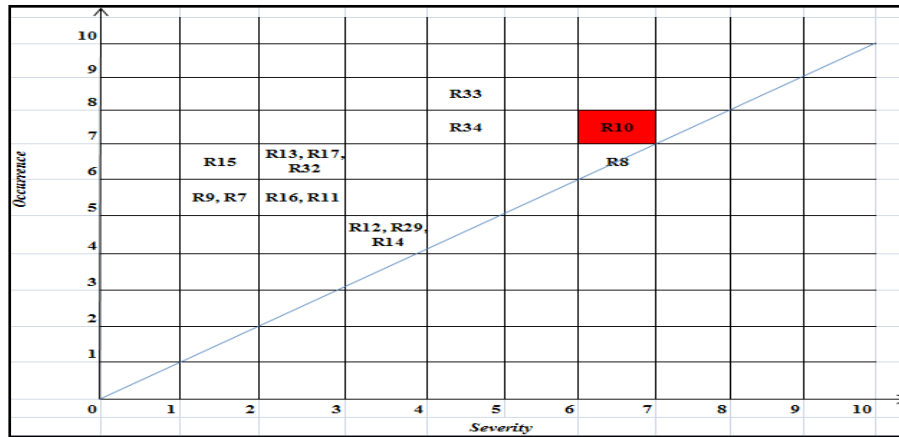


Figure 2. The Criticality Matrix of Rice Miller's Risk

Based on the assessment results, the priority risk of the rice miller is R10 (damage to the rice grinder machine), with an RPN of 490 and a very high criticality level. For these priority risks, it is necessary to know the impacts and causes in order to be able to formulate the right mitigation strategy. Apart from discussions with owners of UD Sido Muncul, priority risk mitigation was also based on consideration of

the interrelationships between risks using the ISM method (Appendix 2). Based on the ISM chart for R10, there were only 3 trigger risks and no other triggerable risks. Therefore, the prepared mitigation strategy can focus more on priority risks that can have the greatest impact on the sustainability of rice milling activities. Priority risk data of rice millers can be seen in Table 6 below.

Table 6. Priority Risk Data of Rice Millers

Priority risk	Potential impact	S	Potential cause	O	Mitigation action	D	RPN
R10 Damage to rice grinder machine	- Production delays until the production process stops, which can have an impact on delays in the distribution of rice to customers	7	There was no periodic maintenance	7	- Regular maintenance schedule - Always check the condition of the machine before and after use	10	490

		- Decrease in production - Expenses for machine repair costs	The machine was used continuously	- Provision of spare engine components - Operate the machine according to the instructions for use		
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3.2 Priority Risk Mitigation Strategies

Analytical Hierarchy Process (AHP) is a method used to create a mitigation strategy that focuses on reducing the frequency and impact of priority risks. Based on Tables 4 and 6, data on causes will be the criteria and data on proposed mitigation will be the alternatives. The assessment of the AHP method uses pairwise comparison. Priority risk mitigation strategies

were selected from the criteria and alternatives that have the highest weight.

3.2.1 Priority Mitigation Strategies of Farmers

The results of the weighting of the priority risk criteria and alternatives from the farmers can be seen in Figure 3 below.

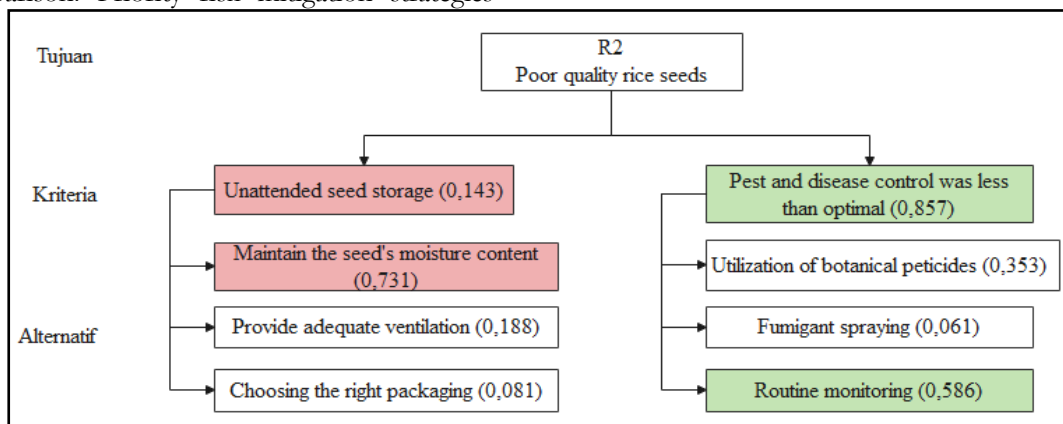


Figure 3. Hierarchical Structure of Farmer's Priority Risk Mitigation Strategies

Priority 1 for the criteria was pest and disease control less than optimal (K2), with a weight of 0,857. K2 has a higher weight than K1 (unattended seed storage), which is less important and only has a weight of 0,143. This is because K2 was the cause of the priority risks that most often occur and were quite difficult to handle compared to the unattended seed storage (K1). The populations of pests and diseases that attack rice plants were dynamic due to the influence of climate and humidity. Meanwhile, the genetic resistance of planted rice varieties can decrease, so developments in pest and disease control that have the ability to adapt are needed (Indiati and Marwoto, 2017). Furthermore, if the cause of this priority risk occurs, it may result in losses greater than K1. So the K2 criteria (pests and diseases was less than optimal) was the cause of the risk that needed to be prioritized to be handled.

The first priority for the K1 criteria (unattended seed storage) was to maintain the seed's moisture content (A1), with a weight of

0,731. Alternative A1 has the highest weight compared to other alternatives. Alternative A2 or provides adequate ventilation, only has a weight of 0,188. Meanwhile, alternative A3 or choosing the right packaging only has a weight of 0,081. This is because alternative A1 was considered the most effective for mitigating K1. The alternative of providing adequate ventilation (A2) and choosing the right packaging (A3) has not been able to optimally mitigate the K1 criteria.

Sari & Faisal (2017) found that adequate ventilation and proper packaging selection were supportive in an effort to maintain the quality of stored seed. Although both have the potential to minimize the impact and frequency of occurrence of K1 criteria, the main point in good storage still lies in the moisture content of the seeds. Seed moisture content has a major influence on seed storability. High seed moisture content results in faster quality degradation. (Justice and Bass, 2002 in Tefa, 2017). Thus, maintaining seed moisture content (A1) is a risk

mitigation proposal that needs to be prioritized for implementation.

The first priority 1 for the K2 criteria (pest and disease control was less than optimal) is alternative B3 (routine monitoring), with a weight of 0.586. Alternative B3 has the highest weight compared to other alternatives. Alternative B1 (utilization of botanical pesticides) has a lower weight of 0,353. Meanwhile, alternative B2 (fumigant spraying) only has a weight of 0,061. This is because alternative B3 was considered the most appropriate to mitigate the K2 criteria.

Alternatives B1 (utilization of botanical pesticides) and B2 (fumigant spraying) have not been able to mitigate the K2 criteria optimally. Even though the use of botanical pesticides can reduce the occurrence of environmental pollution, they still tend to be less effective when compared to chemical pesticides. Botanical pesticides are very sensitive to the influence of environmental factors such as sunlight, temperature, etc. Botanical pesticides are also more easily biodegradable, so they need to be applied repeatedly, so their availability is limited (Sutriadi et al. 2019). On the other hand, spraying fumigants, although quite effective, is classified as very toxic. Fumigants can have a

bad effect if exposed to humans continuously, even in low concentrations. Spraying of fumigants must also be carried out by experts equipped with personal protective equipment (Ministry of Agriculture, 2007).

Although both have the potential to minimize the impact and frequency of the K2 criteria, monitoring activities are more needed for controlling pests and diseases. By conducting regular monitoring, farmers will receive information regarding the development of pests, the role of natural enemies, the climate and the environment. This information is useful for knowing the condition of the land ecosystem, which is always changing and developing. In addition, it is also a consideration regarding what steps need to be taken to control pests and diseases (Indiati and Marwoto, 2017). So that routine monitoring (B3) becomes a risk mitigation action that needs to be prioritized for implementation.

3.2.2 Priority Mitigation Strategies of Rice Miller

While the results of the weighting for the criteria and alternatives of the rice miller's priority risks can be seen in Figure 4 as follows:

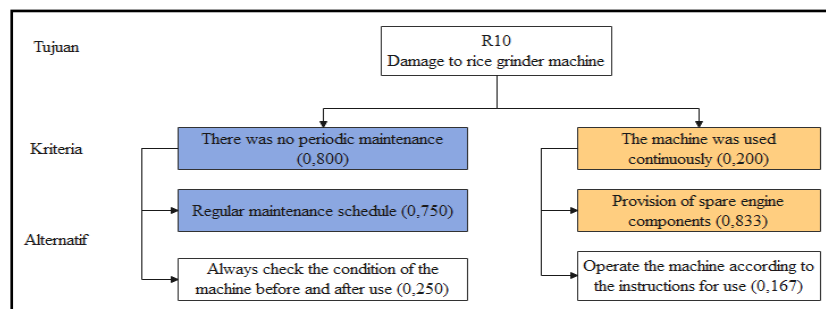


Figure 4. Hierarchical Structure of Rice Miller's Priority Risk Mitigation Strategies

Priority 1 for the criteria was K1 (no periodic maintenance), with a weight of 0.800. Criterion K1 has a higher weight than criteria K2 (a machine that is used continuously), which only has a weight of 0.200. This is because the K1 criterion is the cause of the priority risk that is most likely to be handled compared to the K2 criteria. Continuous use of machines during the harvest season is very difficult to avoid. The impact of K2 criteria can also be minimized indirectly if K1 criteria are handled. So that the control of K1 criteria (the absence of periodic maintenance), is the cause of the risk that needs to be prioritized to be handled.

The first priority for the K1 criteria (there was no periodic maintenance) was alternative A1 (regular maintenance scheduling), with a weight of 0,750. Alternative A1 has a higher weight than alternative A2. Alternative A2 (always check the condition of the machine before and after use) only has a weight of 0,250. This is because alternative A1 was considered better at mitigating risk than alternative A1. Although alternative A2 has the potential to minimize the impact and frequency of the K2 criteria, it has not been able to mitigate them optimally. Alternative A2 is only carried out when production activities are in progress, while

machine maintenance also needs to be carried out when the machine is not operating. With regular scheduling, maintenance can reduce downtime, extend machine life, and maintain invested capital. In addition, proper maintenance can minimize the impact and possibility of engine damage (Nasution et al. 2021). So that periodic maintenance scheduling (A1) becomes a risk mitigation action that needs to be prioritized to be implemented.

The first priority for the K2 criteria (the machines used continuously) was alternative B1 (providing spare engine components), with a weight of 0,833. Alternative B1 has a higher weight than alternative B2. Alternative B2 (operate the machine according to the instructions for use) has a lower weight of 0,167. This is because alternative B1 was considered better at mitigating risk than alternative B2. Although alternative B2 has the potential to minimize the impact and frequency on the K2 criteria, the instructions for using the machine were only used as a guide in operating the machine. In fact, when the harvest season arrives, the machine has to operate almost all day because of the abundant grain stock. Meanwhile, even though the provision of spare engine components can only minimize the impact of the occurrence of K2 criteria, it can save time in the event of engine failure. So that the damage to the machine does not have a significant effect, and production activities for the distribution of rice can continue (Budingsih and Jauhari, 2017). For this reason, the provision of spare engine components (B1) was a risk mitigation action that needed to be prioritized for implementation.

4.CONCLUSION AND SUGGESTION

4.1. Conclusion

Based on the results of research that has been conducted previously, it can be concluded as follows:

1. Based on data processing using the ISM method, it is known that priority risks of farmers have 7 trigger risks and 5 triggerable risks. Based on the results of the risks correlation that can be considered, there are 11 risks that can be overcome by the 6 alternative mitigation that exist. As for rice millers, there are 3 triggerable risks. There are 6 risks that can be overcome by the 4 alternative mitigation that exist,
2. Based on data processing using the FMECA method, the results for farmers show 26 risks

that were at a very low to medium critical level. The priority risk for farmers is R2 (poor quality rice seeds), with an RPN of 112 and a medium criticality level. As for the rice millers, show 15 risks that were at a very low to very high critical level. The priority risk of the rice millers is R10 (damage to the rice grinder machine), with an RPN of 490 and a very high criticality level, and

3. Based on data processing using the AHP method, 6 mitigation strategies were obtained for priority risks of farmers. From all these mitigation strategies, the priority mitigation was maintaining seed moisture content (A1) with a weight of 0.731 and routine monitoring (B3) with a weight of 0.586. Meanwhile, for the priority risk of rice millers, there were 4 mitigation strategies. From all these mitigation strategies, the priority mitigation was provision of spare engine components (B1) with a weight of 0.833 and periodic maintenance scheduling (A1) with a weight of 0.750.

4.2. Suggestion

This suggestion is addressed to supply chain players, especially to farmers and rice millers, whose hopes can be realized in an improvement in the PPU's rice supply chain. In addition, it is also a recommendation for future research. Here are some suggestions given by researchers:

1. Regular monitoring is performed to determine the condition of rice as well as pests and diseases that attack, allowing for more targeted actions.
2. Scheduling regular machine maintenance to ensure that the machine is always in good working order,
3. In further research, it is also related the risk correlation in determining priority risks, and
4. In further research, risk mitigation is also determined for each major risk category.

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